Original Research Article

DIALLEL ANALYSIS OF THE BREAD WHEAT (*Triticum aestivum L.)* IN THE SOUTHERN REGIONS OF THE REPUBLIC OF UZBEKISTAN

Abstract

Diallel analysis assumes that the genetic interactions contributing to trait variation can be adequately captured by GCA and SCA effects. However, in reality, genetic interactions can be more complex, involving higher-order epistatic interactions, pleiotropy, and other factors that are not accounted for in the traditional diallel analysis, for this purpose, studies were conducted to study the combinatorial ability of wheat varieties widely planted in Uzbekistan.

The mode of inheritance for the 1000- kernel weight, vegetation period, plant height, vitreousity, grain yield, mass of grain in the ear and productive accumulation of 4x4 full diallel crosses of wheat varieties was estimated in F_1 generation. The results indicated significant differences between the parents for General Combining Ability and cross for Specific Combining Ability, reciprocal effect for 1000- kernel weight, vegetation period, plant height, vitreousity, grain yield, mass of grain in the ear and productive accumulation. However, analysis of variance of combining capable for grain yield indicated that General Combining Ability and Reciprocal effects were highly importance while Specific Combining Ability. Highly significant General Combining Ability and Specific Combining Ability variances showed the predominance of additive, epistatic and dominant genes in controlling this character.

In the process of hybridization, the application of the original biped gene is important, and for its appearance in the generation, it is necessary to choose a positive line of General Combining Ability. In this way, it will be possible to pre-estimate the characteristics of the future.

A positive and negative heterozygosity for the parent was found for the studied trait, which increased the genetic diversity of the parents.

Keywords: General Combining Ability, Specific Combining Ability, bread wheat, plant height.

1. INTRODUCTION

Climate change brought on by global warming affects agricultural production, notably wheat (*Triticum aestivum* L.) ensures 20% of the calories and 25% of proteins daily consumed worldwide. Although being produced under diverse environmental conditions, is one of the crops most affected by mean temperature increase during the growth season as each degree Celsius increase reduces wheat yield by 4.1% to 6.4% [1]. Several yield parameters are negatively

affected by high temperatures as vegetative weight, grain number and weight [2]. The world bulging population will demand more grains and grain products in future. Even in the present era, the precise requirements for wheat cultivars are growing. The updated forecasts of the Statista show that in 2022-2023 the global wheat production will reach 781.31 million tons, which is 0.5% lower than last year's highest figure, however, it was still a high level of crop production (Statista, 2023). In 2019, world wheat production was 761.51 million tons, with an increase of 3.9% over the year 2018 [3].

The productivity of hybrids is determined by the compatibility of applied varieties or parent forms in the process of hybridization, and is seen in the appearance of the desired gene or character in future generations [4]. Genetic potential is rarely seen in the phenotype of parental forms, therefore it is studied by analyzing offspring. If the parent forms give strong offspring, then they are a good match [5]. The height of the grain, the thickness of the grain, and the thickness of the grain are shown in the size chart. Measuring, measuring, and finding the they done with precision, and the they given a quantitative assessment. That's why we call it a limit [6], [7]. Parent forms will have different combinatorial abilities depending on the character being selected [8]. In addition to quality, there are many quantitative indicators. The brewing and spinning of They has a perfect basis. Since such a marker is twisted in the polygenic fold, the boundary of the phenotypic fold in F_2 is not clearly visible. That is why the combinatorial variation in F_2 will disappear in a continuous state.

In the development and selection process of wheat varieties, the combing ability of the wheat is of great importance in the selection of the parent cultivar. The advantage of this method is that it is possible to determine the breeding value of the variety based on the results of the performance of the second and second generations [9]. Combin ability - the ability to produce high genetic quality in the crossbreeding of the parent form. It is possible to determine the root meaning of the gene and the function of the gene, to learn the signs and functions of the organism, and also to learn the wisdom of the studied form [10]. The importance of the effects of genes in hybridization and the dispersion of genetic components in the studied characters is the dependence of certain specific combinations of hybridization and vegetation conditions [11].

In the F_1 and F_2 generations, the effects of interspecific genes on the heritability of grain size in the ear were found to be differentially expressed depending on the hybridization combinations, and this study showed significant epistatic effects in explaining the genetic variability of the traits [12].

Combining ability is divided into two types: General Combining Ability (GCA) and Specific Combining Ability (SCA). GCA is closed as the total value of

the heterause in the compounds all hybrid, which is obtained in this form. SCA is defined by the amount of heterogeneity in a certain combination, and when the line is crossed with another unique form, the sign is characterized by increased intensity and frequency [13].

2. METHODS

2.1 Research Implementation

In the process of hybridization, cutting is generally accepted V.Ya. According to Yurev et al., pollination was carried out in the Twell unit developed in the CIMMIT international map [14]. 3 mother spikes were taken from each variety.

In order to create a new variety with high productivity and grain quality for the cultivated area, in the field of the Southern Agricultural Research Institute, three varieties of bread wheat (Triticum aestivum L.) in 2019-2020. Zarrin, Bunyodkor, Jaykhun and Gozgon varieties, were fully diallel crossed and the resulting hybrids were analyzed in the F_1 generation. every one was planted in a combination of 50 seedlings with a parent of 20 x 10 cm, and General combining ability (GCA), Specific combining ability (SCA), Reciprocal combining ability (RCA) were determined and carried out using the Griffing method.

In the first year of the study (2018-19), the parental genotypes were planted for cross-breeding under field conditions. In order to obtain offspring in 12 combinations of 4 varieties and multiply seeds in the next generations, 10 spikes and 10 spikes were crossed in each combination. The obtained seeds were sown with 12 F_1 and 4 parental forms in 5 replicates in one row at 25 cm spacing each. Uniform field practices were used throughout the experiment to eliminate experimental errors. OPSTAT provides the analysis of diallel crosses laid out in Randomised Block Design using Griffing's (1956) approach (Method-1 Parents + F_1's + reciprocals methods).

The hybrid was planted by hand in the "maternal-hybrid-paternal" plant. The statistical analysis of the obtained results was carried out using the multivariate analysis (ANOVA) method.

Table 1. Varieties used in diallel analysis of wheat bread

№	Crosses
1	Zarrin x Bunyodkor
2	Zarrin x Gozgon
3	Zarrin x Jaykhun
4	Bunyodkor x Zarrin
5	Bunyodkor x Gozgon
6	Bunyodkor x Jaykhun
7	Jaykhun x Zarrin

8	Jaykhun x Bunyodkor
9	Jaykhun x Gozgon
10	Gozgon x Zarrin
11	Gozgon x Bunyodkor
12	Gozgon x Jaykhun

2.2 Data Analysis The significant data obtained after ANOVA of all the characters on 12 F_1 hybrids and their 4 parental genotypes was put forward to the combining ability analysis as according to Griffing's (1956) Method-I based on Eisenhart's Model-II (Singh and Chaudhary, 1979) as follows [15].

3. RESULTS AND DISCUSSION

In order to improve the productivity of agricultural crops, it is important to study heterozygous breeding and heterozygous breeding. Diallel analysis is the most commonly used method for assessing the heritability and heritability of a trait. In a completely diallel method, the selection of parents can be carried out with a white-pigmented gene [16]. Non-additive genetic variation plays a dominant role in determining most of the mepocs. The best combos include the best x pact and pact x pact general combos for the set you've learned. For the best combo, the high x high overall combo was very low [17], [18].

7 × 7 complete diallel three-way cross were used to evaluate the combinability of bread wheat. 42 obtained F1 dupagaylap were evaluated and plant height, 1000-kernel weight, spike length, spike conewer analyzed. In this case, it was observed that the combination ability was significantly higher in the parent plant and in the offspring, and the general combining ability was superior according to the parent's parameters, and it was observed that the offspring's combining ability affected the plant height, 1000-kernel weight, and the plant height [19].

The large amount of variability in the population does not allow for the diverse brewing of the bran trait.

3.1 Vegetation period. The use of diallel analysis in the selection of a heterozygous variety with a short vegetation period and the development of a new trancgpeccive variety and ridge in. They basis is very important. In our research, it was found that the Zarrin variety had a positive 1.404 (GCA) and a positive 3.276 (GCA) was observed in the Gozgon variety. It was observed that Bunyodkor (-3.451), Jaykhun (-1.161) had negative (GCA) (Table 1).

Table 2. Vegetation period in bread wheat F_1 hybrid generation

combing ability

	Zarrin	Bunyodkor	Jaykhun	Gozgon

Zarrin	1.404	-3.451	3.161	-0.516
Bunyodkor	-0.020	-3.519	-3.546	3.766
Jaykhun	0.130	-0.300	-1.161	0.729
Gozgon	0.010	0.330	0.090	3.-276

General Combining Ability (diagonal values), Specific Combining Ability (above diagonal) and Reciprocal Effects (below diagonal)

Specific combining ability (SCA) Zarrin/Jaykhun 3.161 and Bunyodkor/Gozgon 3.766 have a positive (SCA) presence, Zarrin/Bunyodkor (-3.451), Bunyodkor/Jaykhun (-3.546), negative (SCA) was observed in the combination. When the cross-breeding ability (RCA) of this variety was studied, it was found that the Bunyodkor/Zarrin and Jaykhun/Bunyodkor combinations have a slight negative (RCA), while the rest of the combinations have a slightly positive correlation.

3.2 Plant height. Plant height is a sign of cross-breeding, and if the height of wheat is too high, it will lead to the loss of fertility lifetime to the laying down of the stalks that are prone to rain. The compactness of the wheat stalk leads to the excessive growth of the stem of the drought-stricken yearling, the small and grainy ear, as a result, the compactness of the yield and quality. Plant height can be optimized by cross-breeding. In our study, in the improvement of plant height, the value of General combining ability was positive 6.848 in Zarrin variety and 0.870 in Gozgon variety. Bunyodkor and Jaykhun variety (GCA) showed values of -0.857, -6.680. In this case, the plant height ensures that the genlap is short or tall, and that it is common (Table 2).

Table 3. Plant height in bread wheat F_1 hybrid generation combing ability

	Zarrin	Bunyodkor	Jaykhun	Gozgon
Zarrin	6.848	2.167	5.490	2.910
Bunyodkor	-0.230	-0.857	-1.455	-0.435
Jaykhun	0.130	-0.340	-6.860	2.298
Gozgon	0.000	0.110	0.120	0.870

General Combining Ability (diagonal values), Specific Combining Ability (above diagonal) and Reciprocal Effects (below diagonal)

Specific combining ability (SCA) was positive 5.490 in the Zarrin/Jaykhun combination, and 2.167, 2.910 (SCA) in the Zarrin/Bunyodkor, Zarrin/Gozgon

combination, negative (-1.455) (SCA) was observed in the Bunyodkor/Jaykhun combination. This variety has both a negative (RCA) and a positive (RCA) behavior when studied.

3.3 Productive accumulation. Productive accumulation is important in grain crops, and the presence of more or less tubers increases the amount of yield. A high level of productive accumulation leads to a large number of ears of corn and, in turn, a large number of grains. The combination ability was analyzed in the studied varieties with diallel analysis. In addition, General combining ability was found to be positive 3.893 in Gozgon variety. In the remaining three Zarrin, Bunyodkor and Jaykhun turns, the ability of the General combination showed a professional value.

According to productive accumulation, a positive (SCA) was observed in the combination of Zarrin/Gozgon 2.860 and Bunyodkor/Gozgon 1.088, Zarrin/Jaikhun (-1.593), Zarrin/Bunyodkor (-1.365), and negative (SCA) was observed in the combination. When this variety's recombination ability (RCA) is studied, Jaykhun/Zarrin and Jaykhun/Bunyodkor combinations have a slight negative (RCA), while the rest of the combinations have a slightly positive correlation (table 3).

table 4. Productive accumulation in bread wheat F_1 hybrid generation combing ability

	Zarrin	Bunyodkor	Jaykhun	Gozgon
Zarrin	-2.135	-1.365	-1.593	2.860
Bunyodkor	0.170	-1.362	0.865	1.088
Jaykhun	-0.090	-1.120	-0.395	0.410
Gozgon	0.070	0.150	0.280	3.893

General Combining Ability (diagonal values), Specific Combining Ability (above diagonal) and Reciprocal Effects (below diagonal)

3.4 Generation mass of grain. The combination ability was analyzed when the mass of grain in the ear spinning was measured in the wheat variety. In addition, it was found that the ability of General combination has a strong positive ability in Zarrin and Bunyodkor careers. In the rest of Jaykhun and Gozgon turn, the ability of General combination showed a professional value. When analyzing the specific combining ability of bread wheat F_1 hybrid generation mass of grain in the early, it was found that the All cultivar has a positive combinatory ability with the Gozgon cultivar. When the Reciprocal ability (RCA) of this variety was studied, it was found that the Jaykhun/Zarrin, Gozgon/Zarrin and

Gozgon/Bunyodkor combinations have a slightly positive (RCA), while the rest of the combinations have a slightly negative correlation (Table 4).

In the selection, grain yield is increased by increasing the weight of one early. A single spike weight of 1000 grains is positively correlated with a single spike weight of 2.0 gram.

Table 5. Bread wheat F_1 hybrid generation mass of grain in the early combination ability

	Zarrin	Bunyodkor	Jaykhun	Gozgon
Zarrin	0.195	-0.522	-0.322	0.268
Bunyodkor	-0.330	0.085	-0.063	0.148
Jaykhun	0.010	-0.020	-0.135	0.087
Gozgon	0.530	0.700	-0.660	-0.145

General Combining Ability (diagonal values), Specific Combining Ability (above diagonal) and Reciprocal Effects (below diagonal)

3.5 1000-kernel weight. Grain weight in spike and 1000-kernel weight have a high degree of correlation with productivity of a single-sized spike. The weight of the grain in the ear does not allow to determine the type of wheat, but it tells about the environmental factor during the grain filling period.

In bread wheat, 1000 grain weight is widely used in the selection of varieties and lines, the main reason for this is that 1000 grain weight is one of the important multipliers in determining yield. This multiplicity is difficult to determine whether the wheat belongs to a certain variety, depending on the environmental factors during the growing season, its entire vegetation period, especially during grain filling.

1000-kernel weight is a multiplier that indicates the bakery and fullness of the grain, affecting its quality indicators. It is a species marker, and therefore depends on the climatic conditions in the area where it matures to a strong degree. The size of the wheat grain depends on the length of the growing season, the length of the earlier, and the length of the ripening period.

In bread wheat, the relationship between spike cone, spike length, 1000-kernel weight, and grain weight in this field was studied in 8 × 8 diallel cross-breeding, and the obtained results showed a positive influence on grain yield [20].

The use of diallel analysis in the development of a new transcription variety of bread wheat above 1000-kernel weight and the ridge will be more important than the previous one. In our conducted research, it was found that the ability of combining bread wheat F_1 hybrid generation 1000-kernel weight was positive

1.404 (GCA) in Zarrin variety and Gozgon variety F_1 hybrid generation 1000-kernel weight was positive 0.594 (GCA). It was observed that the total combinability of F_1 hybrid generation 1000 kernel weight of Jaykhun variety was -0.614, -0.054 (table 5).

Table 6. 1000- kernel weight in bread wheat F_1 hybrid generation combining ability

	Zarrin	Bunyodkor	Jaykhun	Gozgon
Zarrin	0.074	0.379	2.509	0.631
Bunyodkor	3.470	-0.614	-0.354	0.339
Jaykhun	-0.420	1.270	-0.054	-0.631
Gozgon	0.330	-0.250	-0.500	0.594

General Combining Ability (diagonal values), Specific Combining Ability (above diagonal) and Reciprocal Effects (below diagonal)

Specific combining ability (SCA) Zarrin/Jaykhun F_1 hybrid generation 1000-kernel weight is positive 2.509 Zarrin variety is positive (SCA) in all varieties combination, Jaykhun/Gozgon F_1 hybrid generation 1000- kernel weight is -0.631 and Bunyodkor/Jaykhun F_1 hybrid generation 1000 - kernel weight -0.354 value, while negative (SCA) was observed in the combination. It was observed that the F_1 hybrid generation 1000-kernel weight of Bunyodkor/Zarrin and Jaykhun/Bunyodkor combination has a positive RCA.

3.6 Grain yield. Basis diallel analysis was carried out on the results obtained from the F_1 hybrid generation of the combining ability of single-seeded maize. According to the obtained result, the F_1 hybrid generation obtained from the Zarrin variety has a high general combining ability, and the calibrating value of one grain of maize was -3.476. General combining ability The F_1 hybrid generation grain yield obtained from the Bunyodkor variety had a value of 2.169, the F_1 hybrid generation grain yield obtained from the Gozgon variety had a positive value of 1.189, and the F_1 hybrid generation grain yield obtained from the Jaykhun variety had a positive value of 0.119 (Table 6).

Table 7. grain yield in bread wheat F_1 hybrid generation combining ability

	Zarrin	Bunyodkor	Jaykhun	Gozgon
Zarrin	-3.476	-2.436	-3.206	5.214
Bunyodkor	-0.380	2.169	2.159	-3.661

Jaykhun	0.960	-7.090	0.119	0.669
Gozgon	9.030	6.640	-5.480	1.189

General Combining Ability (diagonal values), Specific Combining Ability (above diagonal) and Reciprocal Effects (below diagonal)

Specific combining ability (SCA) of Zarrin/Gozgon combination was positive 5.214 and Bunyodkor/Jaykhun F_1 hybrid generation single-seeded maize was positive 2.169 F_1 hybrid generation of the Bunyodkor/Gozgon combination was observed -3.661 negative (SCA) in one seed. It was observed that the F_1 hybrid generation of the Gozgon/Zarrin and Gozgon/Bunyodkor combination had a high positive (RCA) in one-seeded corn. Gozgon/Jaykhun and Jaykhun/Bunyodkor combination F_1 hybrid generation of single-seeded corn has high negative -5.480 and -7.090 (RCA) Bunyodkor/Zarrin combination weak -0.380 Reciprocal combinatorial ability was observed.

3.7 Vitreousity in bread wheat. In common wheat, grain size determines the quality of the grain and the quality of the cultivar, as well as the genetic strength of the grain. The higher the vitreousity of the grain, the higher the flour yield and quality level (Table 7).

The results of the diallel analysis of the F_1 hybrid generation of the ability of combining grain yield showed a high positive value of 1.424 and 1.301 in Jaykhun and Bunyodkor varieties. It turned out that Zarrin (-3.221) had the highest value for the ability of the general combination.

Table 8. Vitreousity in bread wheat F_1 hybrid generation combining ability

	Zarrin	Bunyodkor	Jaykhun	Gozgon
Zarrin	-3.221	-0.066	-3.149	-1.121
Bunyodkor	1.860	1.301	0.479	2.356
Jaykhun	0.360	-4.570	1.424	-0.676
Gozgon	-0.780	0.880	2.930	0.496

General Combining Ability (diagonal values), Specific Combining Ability (above diagonal) and Reciprocal Effects (below diagonal)

Specific combination ability (SCA) Zarrin/Jaykhun, Zarrin/Gozgon combinations have high values of -3.149 and -1.121. Bunyodkor/Gozgon F_1 hybrid generation 2.356 positive (SCA) was observed. It was observed that Gozgon/Jaykhun and Bunyodkor/Zarrin F_1 hybrid generation were positive (RCA). It was found that Gozgon/Zarrin and Jaykhun/Bunyodkor F_1 hybrid generation have a weak negative (-0.780) and high negative (-4.570) Retciprocal combinatory capacity for grain size.

3.8 Analysis of variance of combing ability for the studied traits. The diallel analysis is a statistical method used in genetics and plant breeding to study the combining ability of different parental lines in a set of crosses. It involves systematically crossing multiple parental lines in all possible combinations to create a set of hybrids. These hybrids are then evaluated for various traits of interest to assess the genetic effects and interactions. The main objective of diallel analysis is to estimate the genetic components that contribute to the observed trait variation. These components include general combining ability (GCA) and specific combining ability (SCA). GCA represents the additive genetic effects of a parent and indicates the average performance of its crosses, while SCA represents the non-additive genetic effects resulting from specific combinations of parents. By analyzing the performance of the hybrids and their parental lines, diallel analysis allows researchers to estimate GCA and SCA effects and understand the importance of additive and non-additive gene actions in determining the trait of interest. This information helps plant breeders identify superior parental lines and make informed decisions regarding cross combinations for further breeding programs. Varieties studied in the study was Signficance, which showed . General Combining Ability 0.87128 signficance, Specific Combining Ability which showed 0.73213 signficance and Due to Reciprocals 0.75437 signficance.

Table 9. Analysis of variance of combing ability for the studied traits.

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Signficance
Due to GCA	3	295.022	98.341	0.236	0.87128
Due to SCA	6	1.494.951	249.159	0.598	0.73213
Due to Reciprocals	6	1.425.160	237.527	0.570	0.75437
Error	735	306.262.819	416.684		

GCA: General Combining Ability, SCA: Specific Combining Ability, DF: Degree of Freedom

4. CONCLUSION. The use of diallel analysis in the development of new transgressive varieties and lines with a high 1000 grain weight of bread wheat is one of the advantages. It was found that the combined ability of 1000 grain weight of bread wheat F_1 hybrids was positive 1.404 (GCA) in the Zarrin variety, and 0.594 (GCA) was observed in the F_1 crossbred of the Gozgon variety. Positive combination ability of Zarrin/Gozgon combination was positive 5.214 and Bunyodkor/Jaykhun combination's F_1 hybrid was positive 2.169.

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